BALD EAGLE SURVEY
PACIFIC COAST OF THE
ALASKA PENINSULA, ALASKA
SPRING 2005

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ABSTRACT
As part of its Wildlife Inventory Plan program, in 2000 the Alaska Peninsula/Becharof NWR (Refuge) initiated a program to monitor adult bald eagle population levels along the Alaska Peninsula Gulf Coast. Survey methods followed procedures established by Migratory Bird Management (MBM) and sampling design initiated during a survey conducted in 1983. In 1983 MBM Pilot/Biologist Hodges surveyed 40 plots; in 2000 we surveyed these original 40 plots plus 10 more plots within the Refuge boundary. From 17 to 24 April 2005 we surveyed the same 50 plots. The total population index from Cape Douglas to Unimak Island was 2,168 $\pm$ 530 (24%) adult eagles. The immature eagle population index was 435 $\pm$ 297 (68%) immature eagles. Although the adult population index decreased from 2000 and the immature population index increased from 2000 neither difference was statistically significant. The number of occupied nests also did not differ statistically between 2000 and 2005 (132 occupied nests in 2000 vs. 114 occupied nests in 2005). In 2005, we used a new method to estimate detection rates for adult bald eagles. Detection rates have not been previously estimated for bald eagle surveys in open habitats such as those found on the Alaska Peninsula. Our method of estimating the detection rate used subjective estimates of the detection probabilities for each adult eagle to build a presumed detection probability distribution. The left seat observer subjectively assigned a probability, to the nearest 1/10, of detection to every eagle sighting. Assuming this distribution to be true led to a correction factor for increasing the Peterson estimate of eagles missed by both observers. Our total adult eagle population estimate should be increased by 28 percent to account for the eagles missed, yielding an adjusted index of 2,775 adult eagles. In addition to the bald eagle observations, we report on observations of other raptors, and large terrestrial and sea mammals made during the survey.

INTRODUCTION
Bald eagles continue to inspire Americans as the National Symbol and in Alaska often represent wilderness values. Bald eagles are still listed as Threatened in the lower 48 states although proposed for delisting in 1999. The population status of bald eagles in Alaska has greatly improved since the days of bounties during territorial years and is thought to be relatively static in Southeast Alaska over the last 25 years (Schempf, e-mail to Iain Stenhouse, 5/31/05, RE: Audubon Watch List). The status of the adult bald eagle population on the Pacific coast of Alaska Peninsula from Cape Douglas to Unimak Island was examined from 17 April to 24 April, 2005. This area encompasses parts of six conservation units (Alaska Maritime National Wildlife Refuge [NWR], Alaska Peninsula NWR, Aniakchak National Preserve, Becharof NWR, Katmai National Park, and Izembek NWR) and Native Corporation land. This project is part of the Alaska Peninsula / Becharof National Wildlife Refuge's (Refuge) draft Wildlife Inventory Plan (2004). The plan outlines the significance of this survey:

> The USFWS is responsible for conserving and protecting bald eagles under the Bald and Golden Eagle Act, all migratory birds under the Migratory Bird Treaty Act, other legislation (e.g., Fish and Wildlife Conservation Act of 1980), and treaty obligations. The enabling legislation for Alaska Peninsula NWR specifically lists bald eagle conservation and habitat protection. Conservation and habitat protection for all migratory birds is included in the Becharof NWR enabling legislation [Alaska National Interest Lands Conservation Act, Sections 302 (1)(B)(i) and 302 (2)(B)(i)].

The Alaska Peninsula, and specifically the Pacific coastline, is a stronghold for the bald eagle. This environment, although isolated, is subject to environmental degradation from transportation corridors and potential mineral extraction outside the Refuge boundaries. Ever increasing human visitation, especially sport hunting and fishing, and ecotourism, also threaten the isolated habitat. Food sources may be impacted by harvests of salmon and other fish outside of Refuge boundaries.

Biologists are increasingly interested in determining the ability of observers to successfully detect the object organism during visual and aural surveys on the ground, and during aerial surveys (Anderson 2001). Migratory Bird Management Wildlife Biologist Tim Bowman suggested attempting to estimate a detection rate for this survey. Bowman and Schempf (1999) determined a detection rate during a survey using similar methods for Southeast Alaska. Detection rates have not been determined for bald eagle surveys in habitat without trees as found on the Alaska Peninsula. Estimation of detection rates provides a means to account for variability in environmental conditions and changes in observers among years. In efforts to improve the population estimate, we attempted collecting additional information that would lead to an estimate of observer detection.

STUDY AREA

The study area covered the Gulf of Alaska coast of the Alaska Peninsula from Cape Douglas (Katmai National Park) to Unimak Island (Alaska Maritime NWR) as well as the offshore islands of Sanak Islands and the Shumigans. The approximate length of the sampled coastline is 1,900 kilometers plus the coastline of the named offshore islands. The area is characterized by the junction of the Aleutian Mountains (including volcanic peaks) with the ocean. Rugged cliffs on many capes are interrupted by glacially carved bays, drainages, and estuaries. Many of the cliff faces are unvegetated or sparsely vegetated. Where vegetation exists, it includes dwarf shrub tundra, low and tall shrubland, a few cottonwood and spruce trees especially within the Katmai boundaries, and a variety of freshwater, estuarine, and marine wetland habitats including rocky intertidal zones. Sea stacks, rocky outcroppings separated from the mainland, are common where cliffs dominate the shore and provide nesting sites for eagles. (See cover photo and Appendix I for photographs of coastal habitat).

METHODS

Field Procedures

The survey method was that described in the Refuge wildlife inventory plan (WIP). This is the same method used for eagle surveys in Southeastern Alaska (Hodges and King 1982, Hodges et al. 1984), on the Alaska Peninsula (Hodges 1983, Savage and Hodges 2000), for damage assessment surveys in Prince William Sound after the Exxon Valdez oil spill (Bowman et al. 1997). We surveyed the same set of 50 plots surveyed in 2000 (Figure 1). The pilot, observer and aircraft were the same as in 2000. All plots are seven nautical miles square. The center point of plot (i, j) has the coordinates:

$$latitude = 57.325 + 0.1167*j,$$
$$longitude = 134 – i*(0.1167/\cos(latitude)).$$

Hodges piloted the turbine beaver (N754) on floats and we used the *Moving Map* program with the instrument panel-mounted computer. A microphone was used with the observer's computer to record each observation. Geographic coordinates were obtained from the airplane's GPS unit corresponding to the voice recordings. During the flight Savage used a modified version of the Bald Eagle Survey form to record details of the flight including take-off and landing time, brief notes on weather and the plot numbers surveyed. A new aircraft tracking system had been installed since our last survey allowing Refuge staff to track the aircraft's whereabouts.

In addition to collecting observations and counts as outlined in the WIP, detection information for adult bald eagles was also collected. We modified our method of recording observations by waiting to verbally announce the observation until it was just passing by the wing of the aircraft. Then for each observation we recorded if the object was observed by Hodges, Savage or both observers. Both observers were looking at the same habitat at the same time, unless they agreed to only observe their respective side of the plane. Hodges estimated a detection probability for each of his observations (e.g., a well hidden bird would be given a low probability of being observed such as 0.2). This method requires an observer with ample experience to make these decisions, but the probabilities do not need to be exact. Of primary importance is the general shape of the probability frequency distribution which is not significantly changed by minor errors in classification. We also noted if the observation was not available to the other observer (e.g., the other observer could not see the observation because of the window angle or because we decided that each observer would only observe on one side of the plane during that section of the plot if habitat was available on both sides).

Wildlife Biologist / Pilot Conant departed Juneau with the Beaver on 7 April and arrived in Anchorage where 100-hour check and routine maintenance was performed at the Aircraft Management (formally Office of Aircraft Safety) hanger. Hodges flew to Anchorage via a commercial flight. On 17 April Hodges flew the Beaver to King Salmon and met Savage. Surveys began that day; five plots were completed. Weather was not conducive to survey on 18 April. On 19 April, we attempted to survey starting at Wide Bay. We terminated the survey after one and a half plots were completed because of low visibility due to snow. On 20 April, we surveyed eight full plots and one half plot near Chignik Bay; on our return we were grounded for two hours at Egegik due to snow and low visibility. A serious wind storm passed through King Salmon on 21 April making it impossible to survey. Due to the threat of another storm building in the Aleutian Islands, on 22 April we flew directly to the Perryville area and worked south, surveying 17 full plots and half of two plots (we fueled at Cold Bay at approximately 1700). We spent the night in Cold Bay at the Izembek NWR bunkhouse. On 23 April we completed one plot near Cold Bay, refueled and worked north completing another ten full plots and half of three plots. On 24 April we completed the survey with four full plots and one half plot. Hodges departed the Alaska Peninsula and arrived in Juneau that evening. The total number of flight hours was 41.7 including ferry time to Juneau for a cost of $12,510. Fuel in Cold Bay totaled

$1,272 and other travel costs totaled $755. The total cost of the survey not including salaries, overtime and hazardous duty pay was $14,537.

Data Analysis

All of the data will be stored on Savage's computer in the directory C:\My Documents\BioArchive\Birdsraptors\AKPEN05 and also backed up on a portable hard drive. The "TR(mm-dd-yy)" files store the aircraft's ground track taken at 5 second intervals. The Akpen*.pos files store the GPS position of each observation that is numbered as recorded. The Akpen*.wav files store the voice recordings. The Akpenspe.cie file and Akpenhea.der files were created and used during transcription of the voice recordings. The transcriptions were stored to the AKP2005.txt file. This was uploaded to AKP2005.xls Excel file which is used for summation and statistical analysis and which can be converted to AKP2005.dbf for use with ArcGIS. The PlotLine.csv file stores the plot corners / coordinates. Paper copies of the BAEASU00.xls file with each observation will be stored along with other paper records in the Refuge Biological file cabinet under "Raptors, Eagles-2005 survey." All electronic files will be recorded onto CD disks and stored at the Refuge and at the Juneau Migratory Bird Management office. The adult, immature, nest and incidental observations will also be loaded and stored on the Refuge's GIS system.

A population estimate for adults and immature bald eagles was determined by calculating a mean, standard deviation and standard error for the sections from Cape Kubugakli to American Bay (25 plots sampled of 77 total) and for the remainder of the Alaska Peninsula (25 plots sampled of 129 total). These means were summed and the confidence limit was calculated using the summed variance estimates for each area.[1] To test if there had been a change in population estimate from 2000 to 2005 a paired t-test was run using the 50 plots sampled in both years. Both adult and immature bald eagle counts were tested for significant differences (p=0.05). Nest occupation on the 50 plots sampled in both years was also compared with a paired t-test. Incidental sightings of other wildlife species are also reported.

Sightability of juvenile eagles compared to adult eagles was examined by comparing the ratio of perched to flying birds for immatures and adult eagles (disregarding adults on nests).

The Peterson Index method of estimating the detection rate requires the assumption that all eagles have the same detection probability for a given observer. The Peterson estimate for eagles missed by both observers is (L * R) / B where L is the number of eagles seen only by the left seat observer, R is the number of eagles seen only by the right seat observer, and B is the number of eagles seen by both observers.

Our method of estimating the detection rate used our subjective estimates of the detection probabilities for each adult eagle to build a presumed detection probability distribution. The left

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1 Confidence Limit = $T_{All} \pm t_{24\,df,\,.05}\,(\,77*(se_1)^2 + 129*(se_2)^2\,)^{.5}$

seat observer subjectively assigned a probability of detection to every eagle sighting.[2] The probabilities were to the nearest 1/10. Assuming this distribution to be true led to a correction factor for increasing the Peterson estimate of eagles missed by both observers. The unique aircraft allowed the left seat pilot to view the right side of the aircraft nearly as well as the right seat observer. Those birds that were below the view of the pilot out the observer's window were classified by the observer as unavailable to the pilot.

RESULTS

The adult eagle population index (with 95% confidence limits) from Cape Kubugakli to American Bay was 656 adult eagles ± 191 and for the remainder of the Alaska Peninsula was 1,512 adult eagles ± 495. The total population index from Cape Douglas to Unimak Island was 2,168 ± 530 (24%) adult eagles. The immature eagle population index for Cape Kubugakli to American Bay was 43 immature eagles ± 28 and for the remainder of the Alaska Peninsula was 392 immature eagles ± 296. The total population index from Cape Douglas to Unimak Island was 435 ± 297 (68%) immature eagles. Table 1 displays the counts of adult and immature eagles for each plot sampled.

The proportion of adult eagles initially seen flying was 12% whereas 59% of immature eagles were initially seen flying. Assuming equal flushing rates for immatures and adults, a better index for total immatures might be 435*0.59/0.12 or 2,139. The proportion of adults first detected while flying was similar in 2000 (11%), but much lower for immatures (38%) in 2000.

The paired t-test between the 50 plots showed a decrease of adult eagles from 2000 to 2005 that was not statistically significant (alpha = 0.05; 2,530 adults in 2000 vs. 2,168 adults in 2005; mean deviation per plot from 2000-2005 was -1.54 ± 2.07 birds). The paired t-test also showed an increase in immature eagles from 2000 to 2005 that was not statistically significant (alpha = 0.05; 299 immatures in 2000 vs. 435 immatures in 2005; mean deviation from 2000 - 2005 was 0.48 ± 0.97. Comparison of the 50 plots is found in Table 2. Also note shaded cells representing a change of more than five eagles in the respective age class per plot (with yellow being a decrease and green being an increase).

During 2005, 136 nests were detected on the 50 plots (Table 3). Nests were recorded as empty or occupied (either incubating or adults present near nest – eggs observed). Twenty-two nests (16%) were recorded as empty and 114 (84%) were recorded as incubating / occupied. We observed eggs at three nests. Comparing the 50 plots observed in 2000 and in 2005, a paired t-test indicated no difference in occupied nest numbers between years (132 occupied nests in 2000 vs. 114 occupied nests in 2005; mean deviation from 2000 - 2005 was -0.36 ± 0.50).

The observed frequency distribution of adult eagles by detection probability class is given in Table 4. This leads directly to estimates of the true number of eagles that were present in each of the detection probability classes (Figure 2). Assuming both observers have the same ability to

2 On the first day of survey and on a few observations, Hodges did not estimate a detection probability.

see eagles, expected sightings are calculated for eagles seen by both observers, for eagles seen by each observer alone, and for eagles missed by both observers. If this estimated probability distribution is correct, then 0.224 should have been the proportion of all observed eagles seen by one observer but not by the other observer. The actual averaged proportion of eagles seen by only one of the observers was 0.195. The calculated correction factor for increasing the traditional L*R/B estimate of eagles missed by both observers was 4.46. We calculate that 74.9 eagles were missed compared to the traditional estimate of 16.8 eagles missed. Our total adult eagle population estimate should be increased by 28 percent to account for the eagles missed, yielding an adjusted index of 2,775 adult eagles.

In addition to bald eagles, we consistently noted all raptors, large concentrations of murres, Northwest crows, bears, moose, caribou, wolverines, fox, seals, and sea lions (although we did not always have a good vantage of the water). We counted all cattle and horses on Sanak Island that we could see on our plots from our shoreline vantage point. We inconsistently noted geese, sea otters and other species of wildlife. These incidental observations are noted in Table 5.

DISCUSSION

In contrast to 2000, weather offered a great challenge to successful completion of this survey. Especially on 19 April, visibility conditions and on 23 April, wind conditions were far from ideal. Because of the threat of upcoming unstable weather we worked a very long day on 22 April. Observer fatigue may have been a factor especially late on this day; however recording detections will help analyze the contribution of any factor reducing detections.

As noted in 2000, the turbine beaver on amphibious floats with panel installed computers and the *Moving Maps* program was again the ideal vehicle to use for this work. For safety reasons during travel to the distant islands, and for the plots along exposed cliffs, we do not recommend the use of a Cessna 206 on floats.

Although not statistically significant, the 2005 population estimate for adult bald eagles is less this year than the 2000 estimate. Immature bald eagle estimates increased. The number of occupied nests was also somewhat lower, but not statistically different from 2000. Changes in adult counts were not correlated with changes in nest count. On 24 plots adult and nest counts changed in the same direction (both positive, both negative, or both no change) while on 17 plots the counts changed in opposite direction. On 9 plots either nest or adult counts were the same as in 2000 so no comparison was made. Plots where counts increased more than five eagles included: two plots at Kujulik Bay / Cape Kumliun (-113 -6, -114 -7), Castle Cape (-116-10), Swedania Point / Unga Straight (-129-16), and two plots on Sanak Islands (-142-25, -143-25). Plots where counts decreased more than five eagles included: Takli Island (-93+6), Kuiukta Bay (-118-11), Mitrofania Bay (-119-12), Perryville (-121-12), Kupreanof Peninsula / Point (-124-15), American Bay (-126-14), Nagai Island (-128-19), Pavlof Bay (-133-15), Deer Passage and Deer Island (-139-20, -139-21), and Cold Bay (-140-19).

The survey was conducted one week earlier than in 2000 to allow for use of the aircraft and pilot on another project. This may have contributed to lower numbers of adults on territory and on nests, however many adults were actively incubating by the initiation of the 2005 survey. It is difficult to compare spring conditions between years for the Pacific Coast. Comparing March and April conditions for 2000 and 2005 in King Salmon, both months in both years were on average drier than the 50 year average, March was on average warmer in both years and April was warmer in 2000, but slightly cooler than average in 2005 (NOAA/WRCC 2005). Weather conditions on 23 April may have also contributed to lower counts on plots surveyed that day. Of the 13 full or partial plots surveyed that day, only two had more eagles in 2005 than in 2000 (one plot had one more adult eagle and one plot had one more immature eagle). The plots surveyed on 23 April are also geographically clustered; an undetected factor may be affecting bald eagle populations along this section of coast. A reported concentration of bald eagles near Perryville was not observed. Perhaps some prey item temporarily concentrated eagles from the nearby plots into an undetected area. The decrease in adults and increase in immature birds noted in 2005 may also indicate changing age structure of the population.

Similar indices between 2000 and 2005 suggest that bald eagle numbers have stabilized on the Alaska Peninsula. Jacobson and Hodges (1999) noted a similar stabilization in eagle numbers from 1982 to 1997 in southeast Alaska. Nesting studies on Kodiak indicated increasing nesting populations from1963 through 2002. During 2003 and 2004 only part of the population was surveyed per the SOP for the Kodiak NWR; some nesting parameters in 2003 and 2004 indicate the population may be stabilizing (Zweifelhofer 2002, 2004).

Adult estimates on plots from Cape Kubugakli to American Bay (Refuge) exhibited less change from 2000 to 2005 (2005 estimate was 93% of 2000) than did plots on the remainder of the Alaska Peninsula (2005 count was 83% of 2000), however immature eagles showed the opposite trend (2005 count was 69% of 2000 for Refuge vs. 2005 count being165% of 2000 for remainder). Both total adult eagles and nest occupancy indicate a healthy eagle population. This year’s estimate added a third point to the population sample for the Alaska Peninsula. Continued monitoring at five-year intervals is recommended.

The uncorrected estimate of immature eagles may be biased low. If we assume that young eagles spend a similar amount of time flying versus perched compared to adult eagles, the ratios calculated indicate an under-detection of immature eagles. However, young eagles may spend more time soaring in the pursuit of food than adults (Stahlmaster, 1987), or may be more wary and displace earlier, so this assumption may not be valid. It is not surprising that perched young eagles may be under-detected because they have more cryptic plumage that blends into the landscape. Our small sample sizes of immature eagles combined with several feeding events that concentrated immature eagles were likely causes of the large difference in percentages of immatures seen in 2000 and 2005.

Estimating detection probabilities for each eagle requires the observer to carefully consider the degree to which the eagle is hidden or camouflaged, or the amount of time the eagle is available to be seen. We found that there is a temptation to place all eagles which are extremely visible into the 100 percent detection category. We soon realized there was a small percentage of the time when each of us had our attention completely diverted from looking out the window, such as while making notes, viewing the map, or looking at the instrument panel. Consequently, the only eagles which were placed in the 100 percent detection category were those that were seen while we were deliberately circling a sea stack and our undivided attention was given to viewing that specific location. At all other times there was the potential that we could be involved with something that could prevent us from seeing a totally obvious eagle.

The shape of the distribution graph of eagles by detection classification determines the correction factor for adjusting the traditional estimate of sightings missed. This correction factor could be used for future surveys when it may not be feasible to estimate detection probabilities for each eagle.

This survey cannot account for eagles with zero detectability (not available to observers). This includes eagles that are soaring too high above the aircraft to be observed, birds that are away from the immediate coastline (i.e., foraging inland or off shore), or birds hidden from airborne observers. One method to estimate availability would be to radio-tag adults and determine with multiple surveys their availability to be detected and whether they are even present on the coastline (Bowman and Schempf 1999). Therefore, even the corrected index should be considered a minimal estimate of population size.

Dewhurst (1990, 1996) found a nest occupancy rate (occupied nests versus total nest detected) of 81% (1990) and 53% (1995) in her nest production studies along the Refuge coastline (subsample of this survey). We estimated an occupancy rate of 77% in 2000 and 84% in 2005. Observers made less effort in 2005 to record every possible empty nest. We felt that evidence of old nests could be observed for many years and was not indicative of a recently active territory. Only empty nests with obvious structure were included. Guidelines for scoring empty nests would help standardize efforts between years and observers and improve the estimates of nest occupation (a commonly reported statistic for nest productivity).

We recommend the continuation of bald eagle surveys using this protocol on the five year schedule now established. As Hodges plans to retire in 2006, and staffing may change at the Refuge, the detection estimate is timely. New detection estimates will tease out the effects of observer on the population index. In future, biologists may wish to time the survey based on weather or biological data indicating seasonal progression. However, the demand on the aircraft rarely allows the luxury of a floating survey window.

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Table 1. Bald eagle counts per plot, Alaska Peninsula Bald Eagle Survey 2005. Plots identified to conservation unit and date surveyed.

Cape Kubugakli to American Bay

			adult				immature		
date	**Conserv.Unit**	**plot**	**perch**	**w/ nest**	**flying**	**total**	**perch**	**flying**	**total**
4/17/2005	Dry Bay, BECH	-100+3				0			0
4/19-24/05	Wide Bay, AKPEN	-102+1	8	10	2	20	1	2	3
4/19/2005	Wide Bay, AKPEN	-103+1	7			7			0
4/24/2005	Agripina Bay, AKPEN	-105-2	6	1	3	10	1	1	2
4/24/2005	Yantarni Bay, AKPEN	-108-4	5	3		8		1	1
4/24/2005	Amber Bay, AKPEN/ANIA	-109-4	2		1	3			0
4/24/2005	Amber Bay, ANIA	-110-4				0			0
4/20/2005	Cape Kumliun, AKMAR	-111-7		2		2			0
4/20/2005	Unavikshak I., AKMAR	-112-7	2	1	2	5	1	1	2
4/20/2005	Kujulik Bay, AKPEN	-113-6	18	1	1	20		1	1
4/20/2005	Cape Kumliun, AKPEN	-114-7	10	6		16	1	1	2
4/20/2005	Dry Creek, AKPEN	-115-7	7			7			0
4/20/2005	Castle Cape, AKPEN	-116-10	16	4	1	21		1	1
4/20/2005	Chignik, AKPEN	-116-9	11	2		13			0
4/20/2005	Seal Bay, AKPEN	-117-11	8			8			0
4/23/2005	Windy Bay, AKPEN	-118-10		3		3			0
4/20-23/05	Kuiukta Bay, AKPEN	-118-11	4	2	2	8			0
4/23/2005	Mitrofania, AKPEN/AKMAR	-119-12	4	2		6			0
4/23/2005	Anchor Bay, AKPEN	-120-12	5	3	1	9			0
4/23/2005	Perryville, AKPEN	-121-12	1			1			0
4/23/2005	Jacob I., AKMAR	-123-14	2	4	1	7			0
4/23/2005	Kupreanof Pen., AKPEN	-124-15	5	1	1	7			0
4/22/2005	Clark Bay, AKPEN	-125-13	12	2		14		1	1
4/22/2005	American Bay, AKPEN/IZEM	-126-14	7	2		9		1	1
4/17/2005	Puale Bay, BECH	-98+3	7	2		9			0

Table 1 con't. Bald eagle counts per plot, Alaska Peninsula Bald Eagle Survey 2005. Plots identified to conservation unit and date surveyed.

Remainder of Peninsula

4/23/2005	Andronica I., AKMAR	-127-17	3	1		4			0
4/22/2005	San Diego Bay,IZEM/AKMAR	-128-15	12	1	1	14	2	2	4
4/23/2005	Nagai I., AKMAR	-128-19	12	9		21		2	2
4/22/2005	Balboa Bay, IZEM	-129-15	8	1	3	12	1	1	2
4/22/2005	Swedania Pt., IZEM	-129-16	7	3		10			0
4/22/2005	Beaver Bay, IZEM	-130-15	5			5			0
4/22/2005	Canoe Bay, IZEM	-131-15				0			0
4/23/2005	Unga I., AKMAR	-131-19	7	3	2	12		1	1
4/22/2005	Pavlof Bay, IZEM	-133-15	8			8	2	4	6
4/22/2005	Pavlof Bay, IZEM	-133-16	2			2			0
4/22/2005	Ukolnoi I., AKMAR	-135-18	8	6	2	16			0
4/22-23/05	Deer Passage, IZEM/AKMAR	-139-20	4	6		10		4	4
4/23/2005	Deer I., AKMAR	-139-21	4	6		10	1		1
4/22-23/05	Cold Bay, IZEM	-140-19	8	1		9	1		1
4/22/2005	Cherni I., AKMAR	-141-23	3	4		7	1	2	3
4/22/2005	SANAK I.	-142-25	13	11	4	28	4	14	18
4/23/2005	Morzhovoi Bay, IZEM	-143-19	9		1	10	1		1
4/22/2005	SANAK I.	-143-24	6	3	2	11	1	1	2
4/22/2005	SANAK I.	-143-25	24	15	7	46	16	7	23
4/22/2005	SANAK I.	-143-26	4	3	4	11	1	2	3
4/22/2005	Ikatan Pen., IZEM	-145-23	11	3		14	2	2	4
4/22/2005	Unimak Bight, IZEM	-151-24	2	4	2	8		1	1
4/17/2005	Kukak Bay, KATM	-91+9	6	1		7			0
4/17/2005	Amalik Bay/ Takli I., KATM	-93+6	6	8	1	15			0
4/17/2005	Dakavak Bay, KATM	-94+6	3			3			0

	Cape Kubugakli to American Bay				**Remainder of Peninsula**			
	Adult		Imm		Adult		Imm	
SubSamp Total	213		14		293		76	
SubSampAverage	8.52		0.56		11.72		3.04	
SubSamp SD	5.99		0.87		9.29		5.56	
SubSamp SE	1.20		0.17		1.86		1.11	
Sample size =25								
Total Plots = 77								
Total$_{KA}$ OR Total$_{REM}$	656.04		43.12		1511.88		392.16	
SE Total$_{KA}$ OR SE Total$_{REM}$	190.51926		27.6492		494.673		295.884	

ALL of AK PEN	Adult		Imm	
Total	2167.92		435.28	
SE TOTAL	256.82808		143.979	
95% Confidence Limit	530.09316	24%	297.173	68%

Table 2. Test for significant differences between bald eagle counts in plots sampled in 2000 and 2005, Alaska Peninsula Bald Eagle Survey. Note shaded cells represent a change of more than five eagles in the respective age class per plot (yellow indicates a decrease and green indicates an increase).

		2005		2000		X_{05}-X_{00}	X_{05}-X_{00}
plot	**Stratum**	**Adults**	**Immat.**	**Adults**	**Immat.**	**Adults**	**Imm**
-91+9*	L	7	0	6	0	1	0
-93+6	M	15	0	21	3	-6	-3
-94+6	L	3	0	6	2	-3	-2
-98+3		9	0	4	1	5	-1
-100+3		0	0	1	0	-1	0
-102+1	M	20	3	20	2	0	1
-103+1	L	7	0	4	1	3	-1
-105-2	L	10	2	5	0	5	2
-108-4	L	8	1	10	4	-2	-3
-109-4		3	0	2	0	1	0
-110-4		0	0	0	0	0	0
-111-7	L	2	0	2	0	0	0
-112-7	L	5	2	7	0	-2	2
-113-6	L	20	1	12	0	8	1
-114-7		16	2	9	1	7	1
-115-7	L	7	0	4	0	3	0
-116-9	L	13	0	10	2	3	-2
-116-10	M	21	1	12	0	9	1
-117-11	M	8	0	4	0	4	0
-118-10		3	0	5	0	-2	0
-118-11		8	0	19	0	-11	0
-119-12		6	0	12	1	-6	-1
-120-12	L	9	0	13	2	-4	-2
-121-12		1	0	8	3	-7	-3
-123-14		7	0	9	0	-2	0
-124-15	L	7	0	15	0	-8	0
-125-13	L	14	1	18	2	-4	-1
-126-14	L	9	1	25	1	-16	0
-127-17	L	4	0	8	1	-4	-1
-128-15	L	14	4	11	4	3	0
-128-19	M	21	2	27	2	-6	0
-129-15	L	12	2	9	0	3	2
-129-16	L	10	0	2	0	8	0
-130-15	L	5	0	4	1	1	-1
-131-15	L	0	0	0	0	0	0
-131-19	L	12	1	9	1	3	0
-133-15	L	8	6	15	3	-7	3
-133-16	L	2	0	5	0	-3	0
-135-18	L	16	0	18	1	-2	-1
-139-20	L	10	4	43	5	-33	-1
-139-21	L	10	1	23	6	-13	-5
-140-19	L	9	1	20	0	-11	1
-141-23	L	7	3	7	1	0	2
-142-25	L	28	18	29	10	-1	8
-143-19	L	10	1	6	0	4	1
-143-24	L	11	2	11	0	0	2
-143-25	L	46	23	33	3	13	20
-143-26	L	11	3	14	1	-3	2
-145-23	L	14	4	19	2	-5	2
-151-24	L	8	1	7	0	1	1
TOTAL		506	90	583	66		

Table 2, con't. Test for Significant Differences between Bald Eagle Counts in plots sampled in 2000 and 2005, Alaska Peninsula Bald Eagle Survey.

Paired t-test	2005-2000 adults	imm
total deviation	-77	24
mean deviation	-1.54	0.48
std dev of deviation	7.28	3.41
std err of deviation	1.03	0.48
mean $\pm$	-1.54$\pm$	0.48$\pm$
confidence interval	2.07	0.97
signficance	Not Sign	Not Sign

Table 3. Nesting activity on each plot for 1983, 2000 and 2005 (NS indicates not surveyed in 1983), Alaska Peninsula Bald Eagle Survey. Paired t-test performed on nest surveyed in 2000 and 2005.

	1983		2000				2005		2005-2000
	Empty	Occup.	Empty	Occup. Active	Occup. Unkn	Not Scored	Empty	Occup. Active	X_{05}-X_{00} Occup.
-91+9		2	1	2			2	1	-1
-93+6	2	7		8				7	-1
-94+6		2	1	1			2		-1
-98+3	NS				1			2	1
-100+3	NS								0
-102+1	1	1	2	4		2		7	3
-103+1	1	1	1	1					-1
-105-2		1	1	1	1			1	-1
-108-4		2		2				2	0
-109-4	NS			1					-1
-110-4	NS								0
-111-7		1		1				1	0
-112-7		1	1				1	1	1
-113-6		2	2	4			2	1	-3
-114-7	NS		1	3				3	0
-115-7		3	3						0
-116-9	1	2		2				1	-1
-116-10	3	4	1	3	1			2	-2
-117-11	2	3		2					-2
-118-10	NS		2	2	1			2	-1
-118-11	NS		1	4				2	-2
-119-12	NS			2	2			2	-2
-120-12	1	1	2	3			1	2	-1
-121-12	NS			1					-1
-123-14	NS			3				4	1
-124-15		3		3				1	-2
-125-13		2		3	1		3	2	-2
-126-14	4	4	3	2	1			2	-1
-127-17		1		1		1		1	0
-128-15	1	2		3		1	1	1	-2
-128-19	3	8	1	5	3	1	2	7	-1
-129-15	1			2		1	2	1	-1
-129-16	1					1		3	3
-130-15				2					-2
-131-15									0
-131-19	1	4	2	1		1	1	3	2
-133-15			1	1			1		-1
-133-16				3			1		-3
-135-18		2	1	4		2		6	2
-139-20	1	2	2	5	3		1	4	-4
-139-21	2	1	1	4		1		6	2
-140-19						1		1	1
-141-23		2		1				3	2
-142-25	1	5	3	11			1	9	-2
-143-19									0
-143-24		1	2	1	1			2	0
-143-25	1	9	3	7			1	12	5
-143-26		3		4	1			3	-2
-145-23		3	1	2				3	1
-151-24	1			1				3	2
	28	85	39	116	16	12	22	114	

Table 3, con't. Nesting activity on each plot for 1983, 2000 and 2005 (NS indicates not surveyed in 1983), Alaska Peninsula Bald Eagle Survey. Paired t-test performed on nest surveyed in 2000 and 2005.

	1983	2000	2005
Empty Nests	28	39	22
Occ / Active	85	132	114
Total	113	171	136
% occupied	75.22124	77	84

Paired t-test: occupied nests 2005 - 2000

total deviation		-18.00
mean deviation		-0.36
std dev of deviation		1.75
std err of deviation		0.25
		-0.36±
		0.50

Table 4. Presumed detection probability distribution for adult bald eagles, Alaska Peninsula Bald Eagle Survey 2005.

Estimated Detection Probability	Observed Frequency	Estimated Eagles Present		Expected Sightings Observer 1	Expected Sightings Observer 2	Expected Sightings Both[1]		Expected Sightings Missed
0.1	5	50.0		4.5	4.5	0.5		40.5
0.2	7	35.0		5.6	5.6	1.4		22.4
0.3	10	33.3		7.0	7.0	3.0		16.3
0.4	5	12.5		3.0	3.0	2.0		4.5
0.5	10	20.0		5.0	5.0	5.0		5.0
0.6	17	28.3		6.8	6.8	10.2		4.5
0.7	29	41.4		8.7	8.7	20.3		3.7
0.8	45	56.3		9.0	9.0	36.0		2.3
0.9	57	63.3		5.7	5.7	51.3		0.6
1	7	7.0		0.0	0.0	7.0		0.0
Total				55.3	55.3	136.7		99.9

[1](Estimated Detection Probability)^2 x Estimated Eagles Present

0.224 = Expected Proportion Seen by one observer only = 55.3 / (55.3 + 55.3 + 136.7)

22.4 = Traditional estimate of expected sightings missed = (55.3 * 55.3) / 136.7

4.46 = Correction factor for estimated sightings missed = 99.9 / 22.4

Actual observations by each observer and by both observers.

51 = Actual number seen by observer one only.
54 = Actual number seen by observer two only.
164 = Actual number seen by both observers.

0.195 = Actual Proportion Seen by one observer only (Average) = [(51+ 54) / 2] / (164 + 51+ 54)

16.8 = Traditional estimate of eagles missed by both observers = (51 * 54) / 164

74.9 = Corrected estimate of eagles missed by both observers = 16.8 * 4.46

344 = Estimate of actual eagles present = 51 + 54 + 164 + 74.9

1.28 = Ratio of actual eagles present to eagles observed = 344 / (51 + 54 + 164)

Table 5. Incidental bird and mammal observations by plot, Alaska Peninsula Bald Eagle Survey 2005.

BIRDS

plot	NWCR	RLHA	PEFA	EMGO	BRAN	MUSP
off plots					20	5000
-100+3						
-102+1						
-103+1						
-105-2						
-108-4						
-109-4						
-110-4						
-111-7						
-112-7						
-113-6						
-114-7				15		
-115-7						
-116-10						
-116-9						
-117-11						
-118-10						
-118-11						
-119-12						
-120-12						
-121-12						
-123-14			1			
-124-15						
-125-13						
-126-14						
-98+3						
-127-17						
-128-15						
-128-19						
-129-15						
-129-16						
-130-15						
-131-15						
-131-19						
-133-15		1				
-133-16						
-135-18						
-139-20						
-139-21						
-140-19						
-141-23						
-142-25						
-143-19						
-143-24						
-143-25						
-143-26						
-145-23						
-151-24						
-91+9						
-93+6						
-94+6						

Table 5, con't. Incidental bird and mammal observations by plot, Alaska Peninsula Bald Eagle Survey 2005.

MAMMALS

plot	Bear	Moose	Caribou	Fox	Wolverine	SELI	HASE	Whale	SEOT	Cattle	Horse
off plot					1		70		1		
-100+3											
-102+1		1					1				
-103+1											
-105-2											
-108-4											
-109-4		1									
-110-4											
-111-7											
-112-7											
-113-6											
-114-7											
-115-7											
-116-10											
-116-9									30		
-117-11											
-118-10											
-118-11	1	1									
-119-12						1					
-120-12											
-121-12								2			
-123-14											
-124-15											
-125-13											
-126-14	1										
-98+3											
-127-17											
-128-15											
-128-19											
-129-15											
-129-16											
-130-15											
-131-15											
-131-19											
-133-15											
-133-16	1s/2c										
-135-18											
-139-20				1							
-139-21											
-140-19											
-141-23										45	
-142-25										33	
-143-19			4								
-143-24										24	5
-143-25										227	1
-143-26						300					
-145-23	2										
-151-24											
-90+10											
-93+6											
-94+6	1	1									

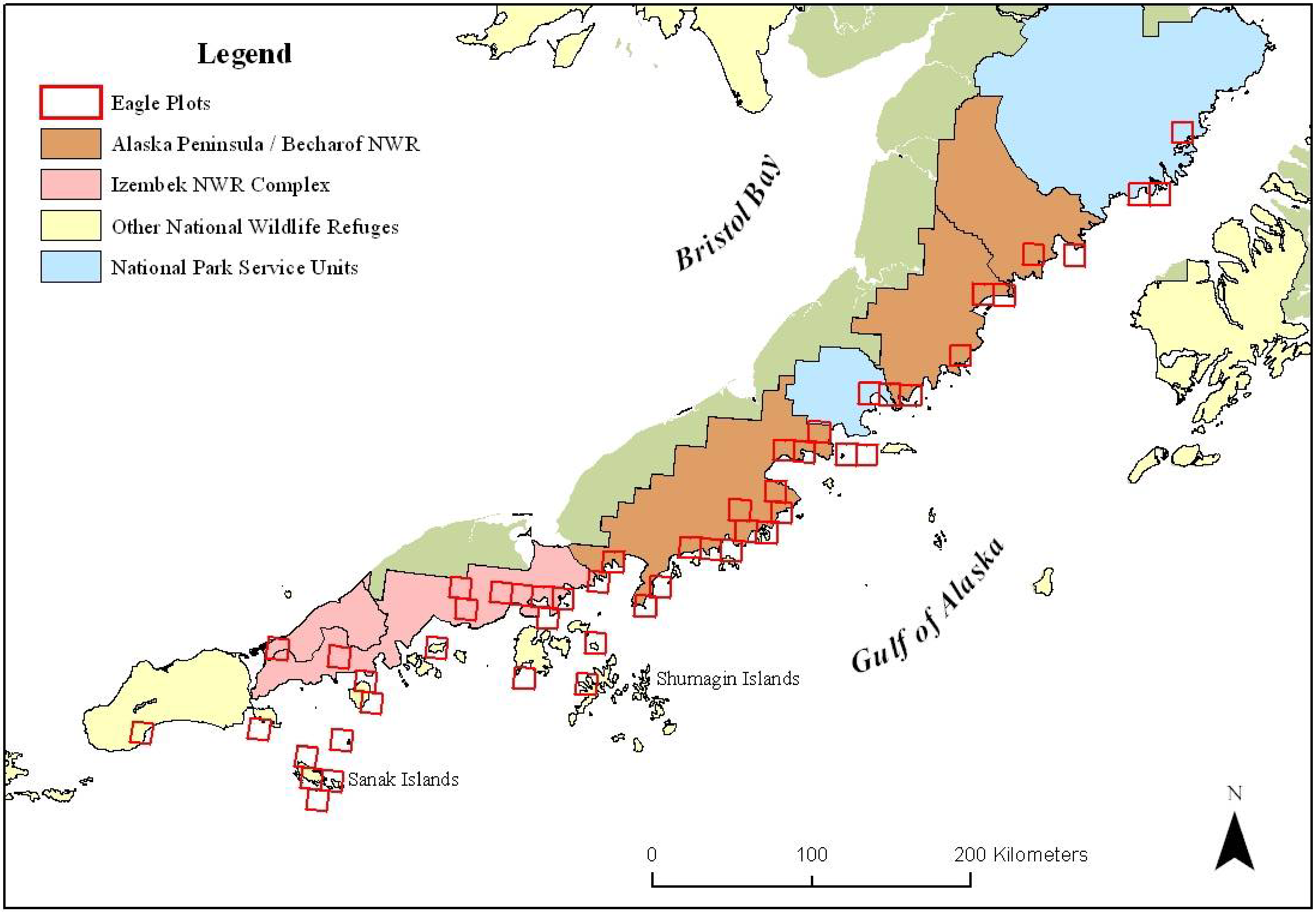
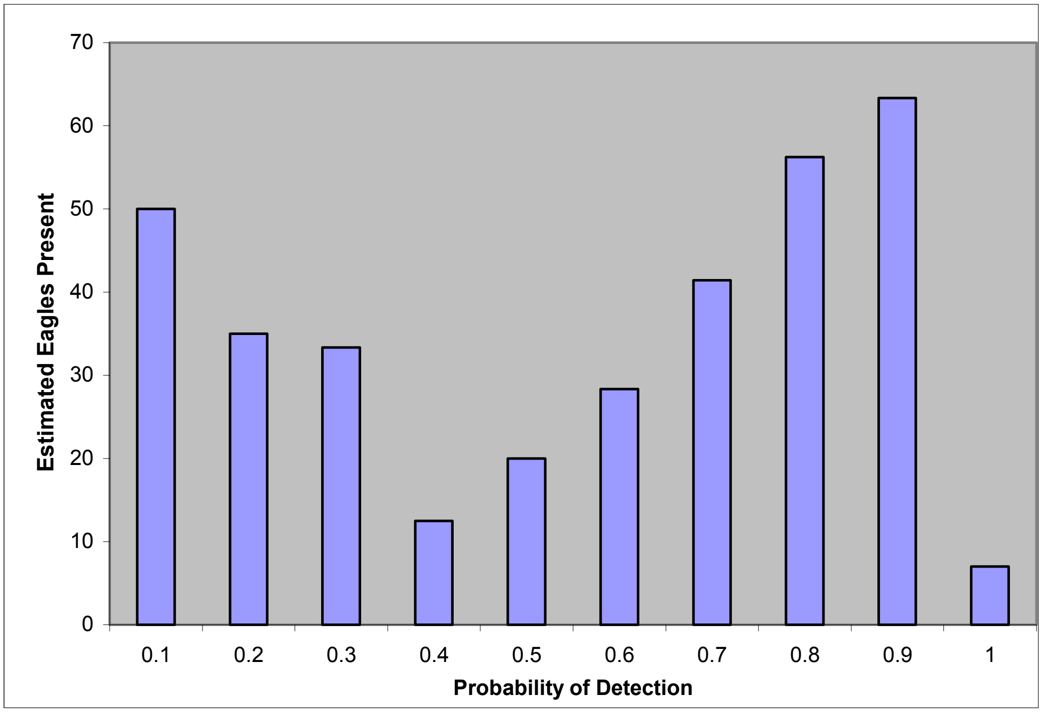


Figure 1. Location of bald eagle survey plots on the Alaska Peninsula, 2005.

Figure 2. Estimated distribution of eagles by probability of detection category, Alaska Peninsula Bald Eagle Survey 2005.



Appendix I. Photographs of the Pacific Coastline included in the survey area.

17 April 2005 near Cape Atushagvik, Katmai NP&P

23 April 2005 Kuiukta Bay, Alaska Peninsula NWR Chignik Unit

24 April, 2005 near Imuya Bay, Alaska Peninsula NWR Ugashik Unit

23 April 2005 Outer Iliasik Island, Izembek NWR Complex (Pavlof Unit)

24 April 2005 Port Wrangell, Alaska Peninsula (Chignik Unit) NWR

23 April 2005 Shumagin Islands, Alaska Maritime NWR